Spinning Reserve from Load

Transmission Reliability Peer Review

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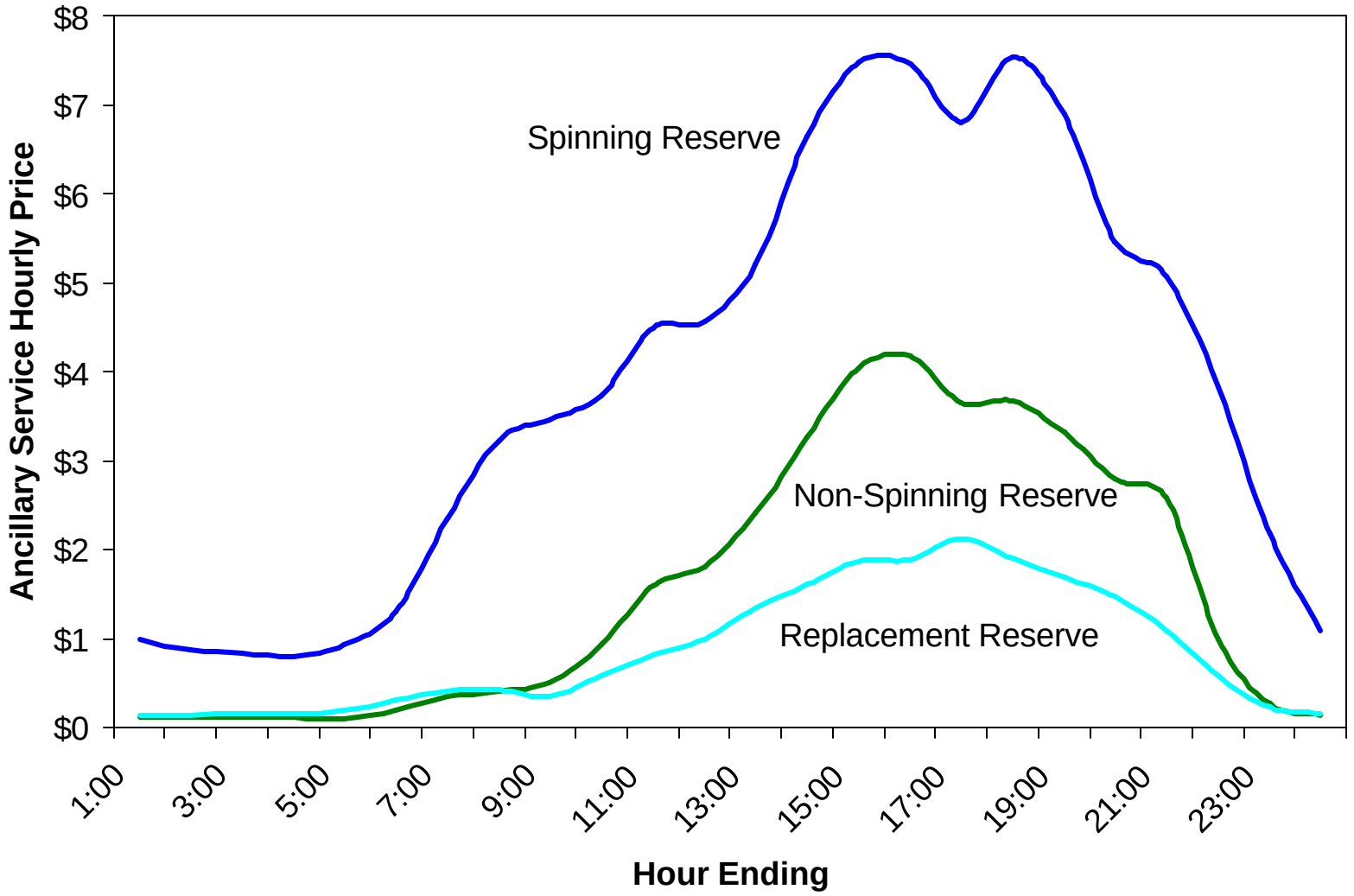
CERTS
CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

Objective, Stakeholders, Accomplishments, Significance, Deliverables

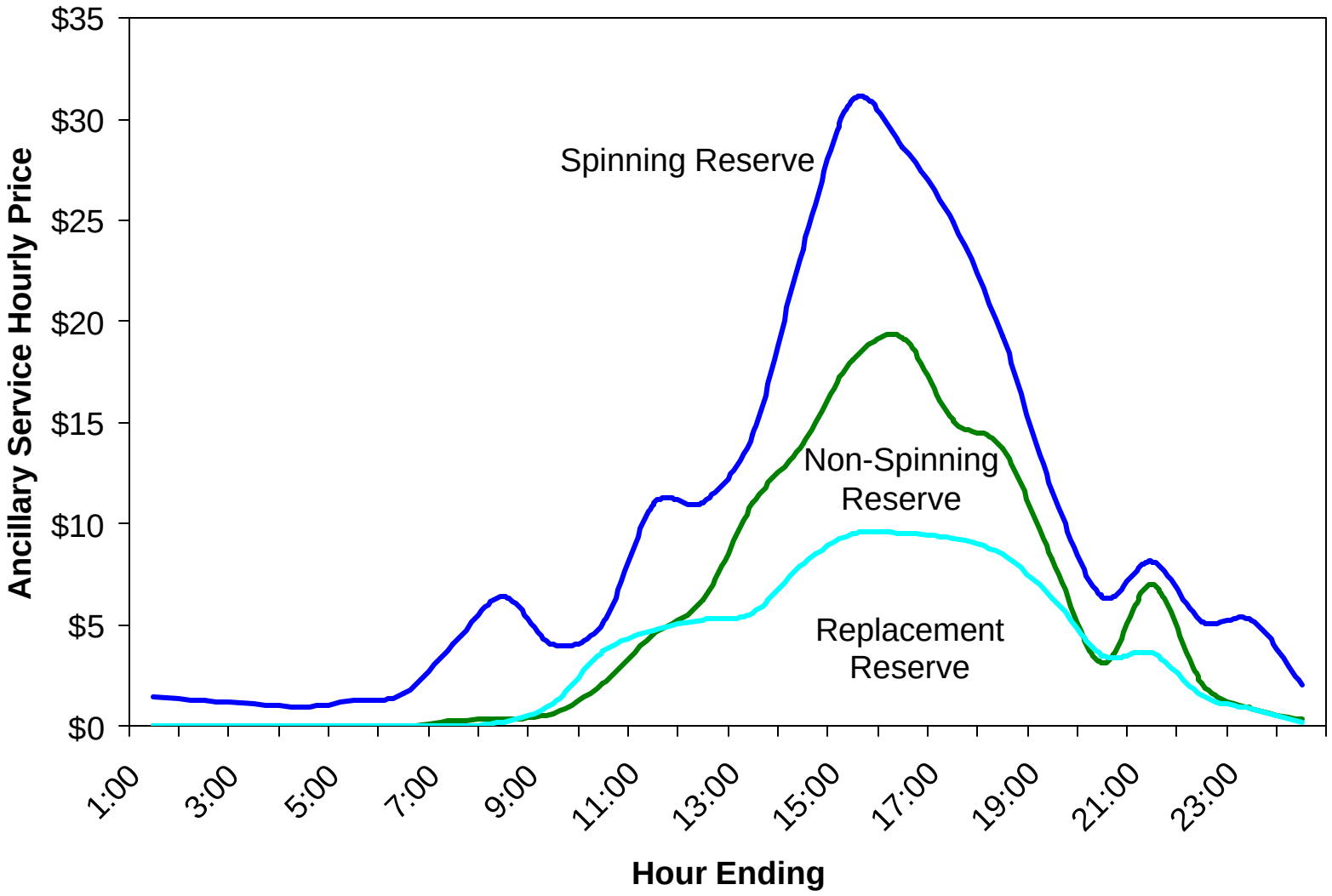
- **Objective: A rule change to permit spinning reserve to be supplied from load.**
- **Stakeholders: FERC, NERC, WECC, CAISO, SCE, CDWR and others.**
- **Accomplishments: FERC and NERC have agreed they have no prohibition against spin from load. WECC MORC has taken rule change under consideration.**
- **Significance: Could meet entire spin requirement.**
- **Deliverables: Report on CDWR opportunities was authorized for publication in December, 03.**

Loads Can Be Ideal Suppliers of Ancillary Services – Especially Spinning Reserve

- **Redundancy – two methods for supplying spinning reserve**
- **Fewer and shorter interruptions than demand reduction or energy market response**
  - **less storage required**
  - **less disruption to normal load operations**
- **Complements energy management and price response, some loads are seeking ways to be better citizens and to save money.**



These prices show the expected daily pattern where prices are low at night and high in the afternoon. Also, spinning reserve, the highest-quality service, is 2.5 times as expensive, on average, as non-spinning reserve.



The daily pattern of hourly CAISO contingency reserve prices for July of 2002 showed the same expected pattern, but the prices are considerably higher than the annual average hourly prices shown in the previous figure.

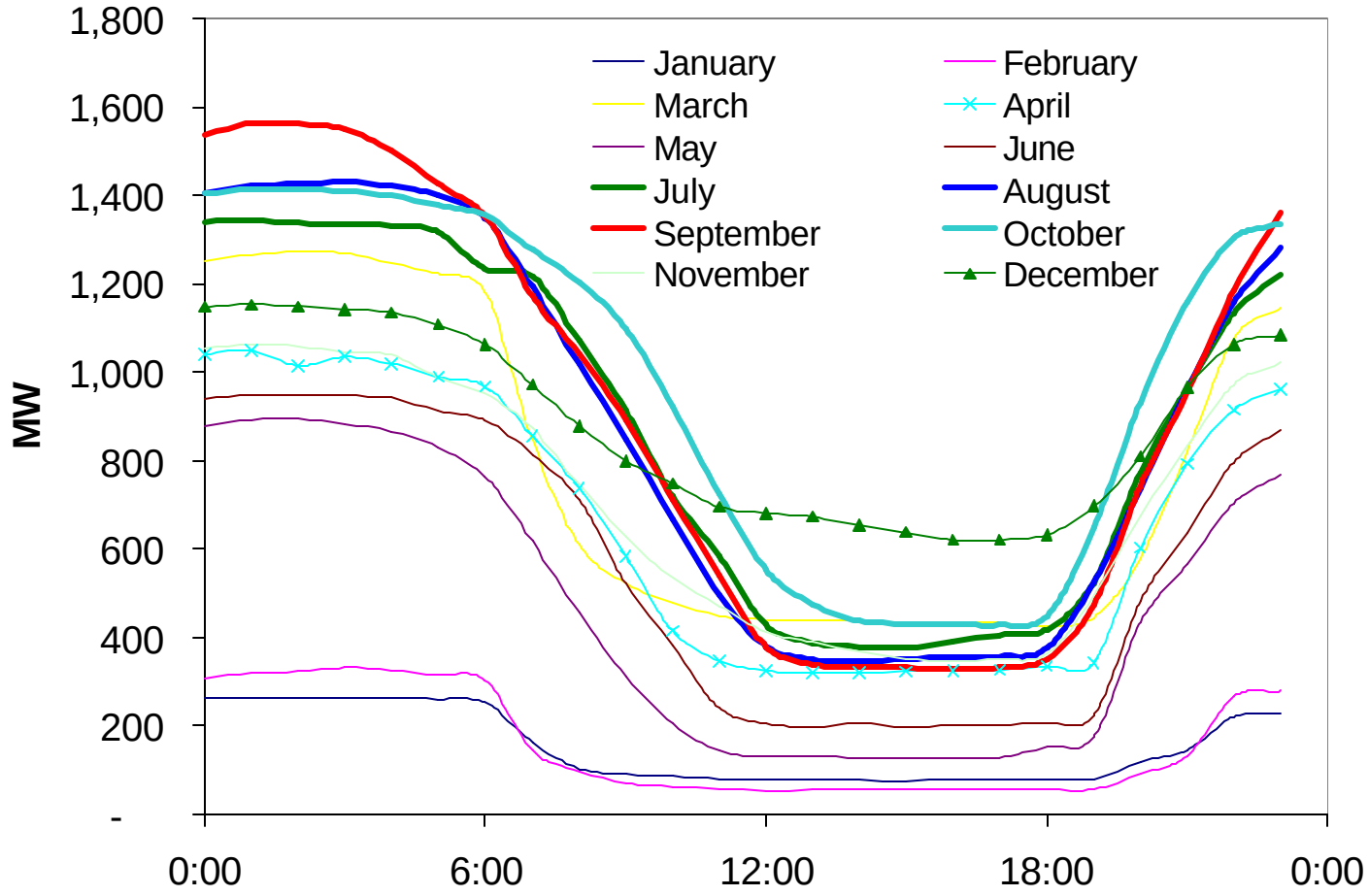
Depending on Location, Loads Offer Other Advantages to Generation

- **Distributed throughout the power system, not lumpy like generation**
- **Fast response and deployment**
- **There are no losses associated in flow of reserves!**
- **A megawatt of load drop can have a much greater impact than a megawatt of generation.**

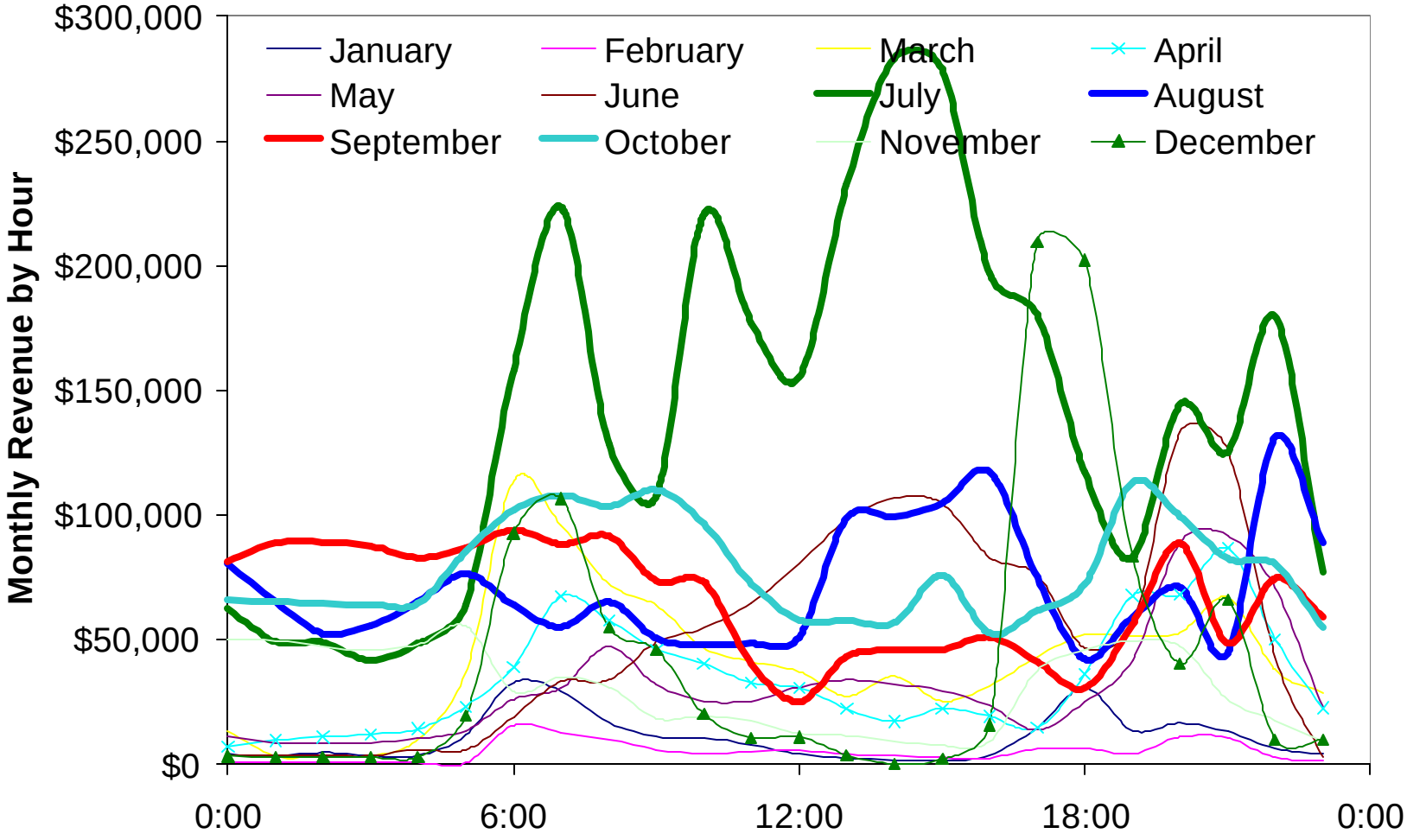
Both Large and Small Loads Are Attractive Spinning Reserve Providers - Current Options Include:

- **CDWR – large pumping loads**
- **Colorado Public Service – Pumped Storage**
- **PacifiCorp Utah Pumped Storage**
- **Others**

CDWR Manages Pumping Loads To Reduce Energy Costs



However, Spinning Reserve Opportunities Are Still Substantial



Total annual revenue from selling spinning reserve could have been $12.9 million in 2002 with 1999 water conditions.

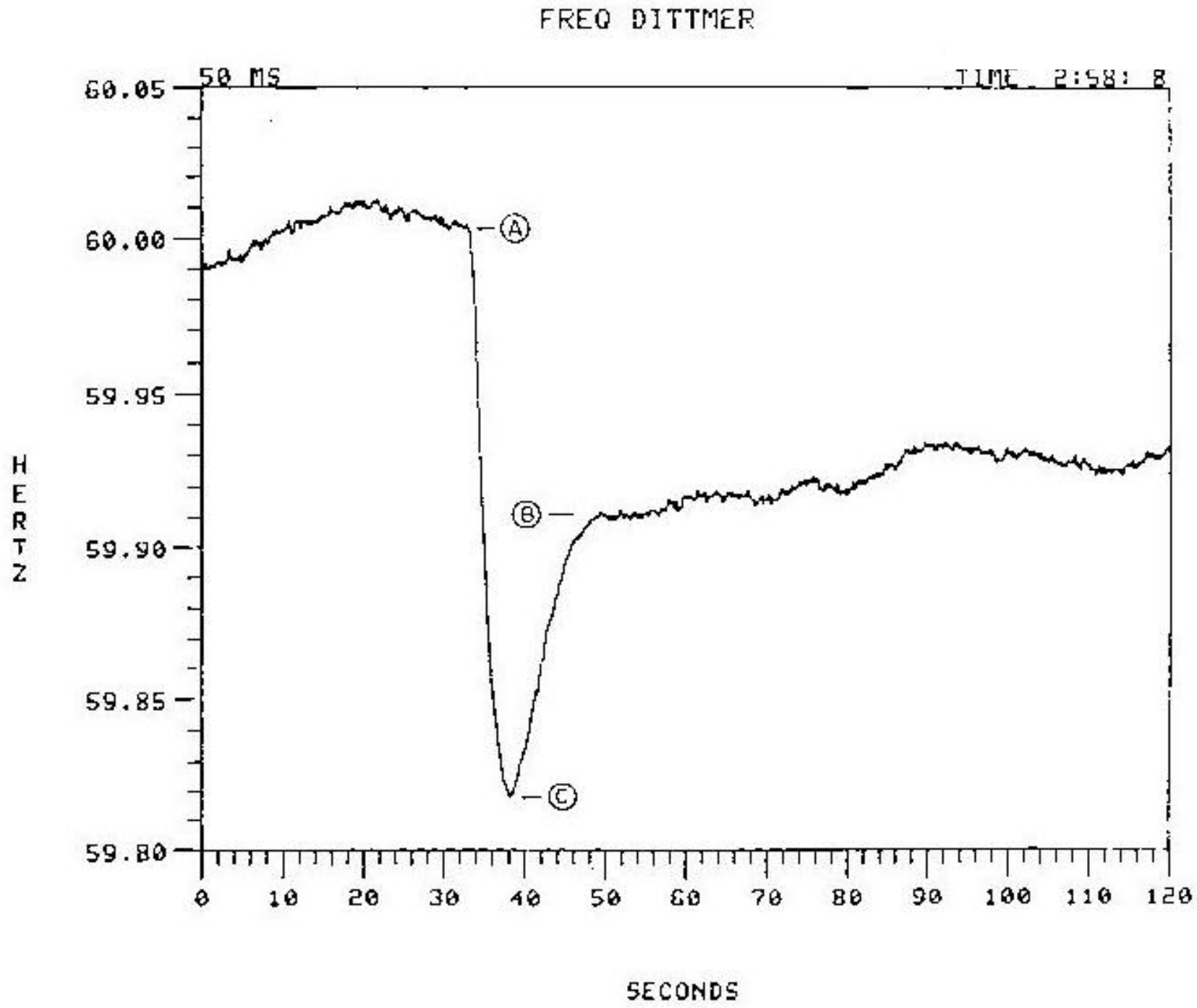
NERC and FERC Positions

- **NERC has indicated that it has no policy against meeting the requirement for spinning reserve from curtailable load, the choice is up to the individual control area.**
- **FERC also has no policy against it and had written a clause into the proposed standard market design saying that spin could be supplied by either generation or load.**

Often Heard Reasons Not to Supply Spinning Reserve from Load

- **Generator rotational inertia helps to dampen oscillations. If spin were supplied from load, the system inertia would be less, and the system would be more susceptible to transients and oscillation.**

Response: Dynamic modeling has shown that when the inertia of generators is scaled, system stability could be maintained even when Southern California inertia was reduced 80% below the minimum limits shown on the SCIT nomogram. Reference Ross Gustromson of PNNL paper.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SECONDS

Often Heard Reasons Not to Supply Spinning Reserve from Load, Contd.

- **Generator rotational inertia is needed to slow the frequency decay (A to C) on initial generator loss before generator speed droop compensation begins to restore frequency.**

Response: **It is true that the slope of the curve from A to C is impacted by the inertia of the system. But even if all the spinning reserve presently required by the WECC were supplied by load, there would be no noticeable impact on the transient undershoot. This has been confirmed by analysis by PNNL.**

Often Heard Reasons Not to Supply Spinning Reserve from Load, contd.

- **How do you know that the dispatched amount of load has been shed?**

Response:

- **Large loads could be tested and certified just like generation.**
- **A statistical response from a large number of small loads is going to be better than the actual response from a few large loads.**
- **The individual control areas could set standards for communication.**

Often Heard Reasons Not to Supply Spinning Reserve from Load, contd.

- **How do you get the frequency responsive droop characteristic of spinning reserve from generation?**

Response:

- **Either individual loads, or the load aggregator, would have to monitor frequency.**
- **Loads could be set to drop sequentially with increasing frequency droop, creating a droop characteristic.**
- **This could even be done as a market function, loads that are more likely to be interrupted (59.064 Hz) could be paid more for their availability than loads at 57 Hz.**

Often Heard Reasons Not to Supply Spinning Reserve from Load, contd.

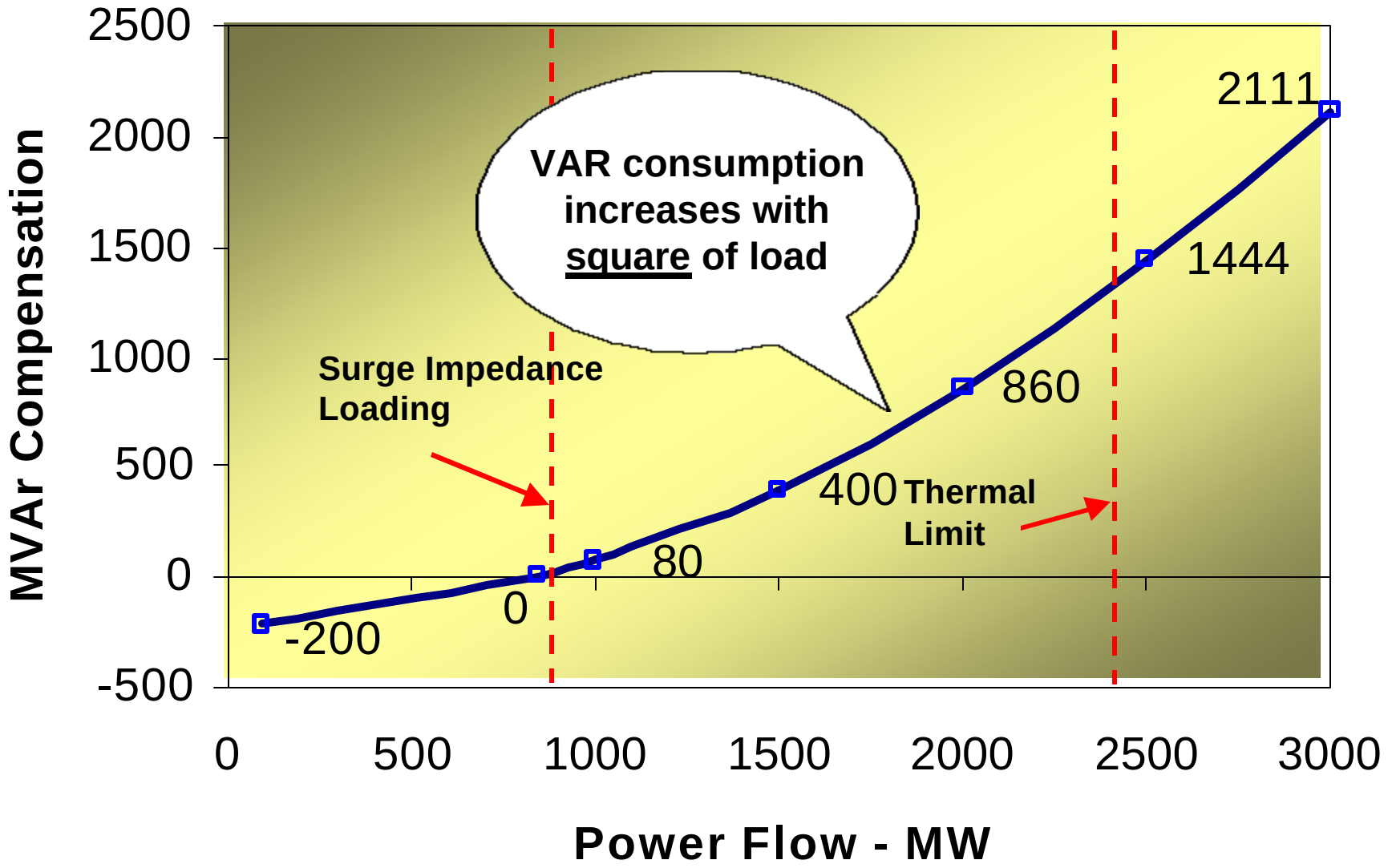
- **Generators connected to the grid but operating at a "backed off" power level provide a large reactive power reserve.**

Response: **This argument is valid. Each control area, however, ensures that they have adequate dynamic reactive reserves. This requirement should not be lumped into the spinning reserve requirement.**

Reasons for Supplying Spinning Reserve from Load

- **During a contingency, load drop is much more helpful to the grid than increasing generation at a distant generator:**
  - **The losses involved in transmission and distribution.**
  - **The reactive power that is consumed by the increase in flow on the transmission line.**
  - **Load drop is fast.**
- **The August 14 blackout was made worse by flow triggered phenomena.**

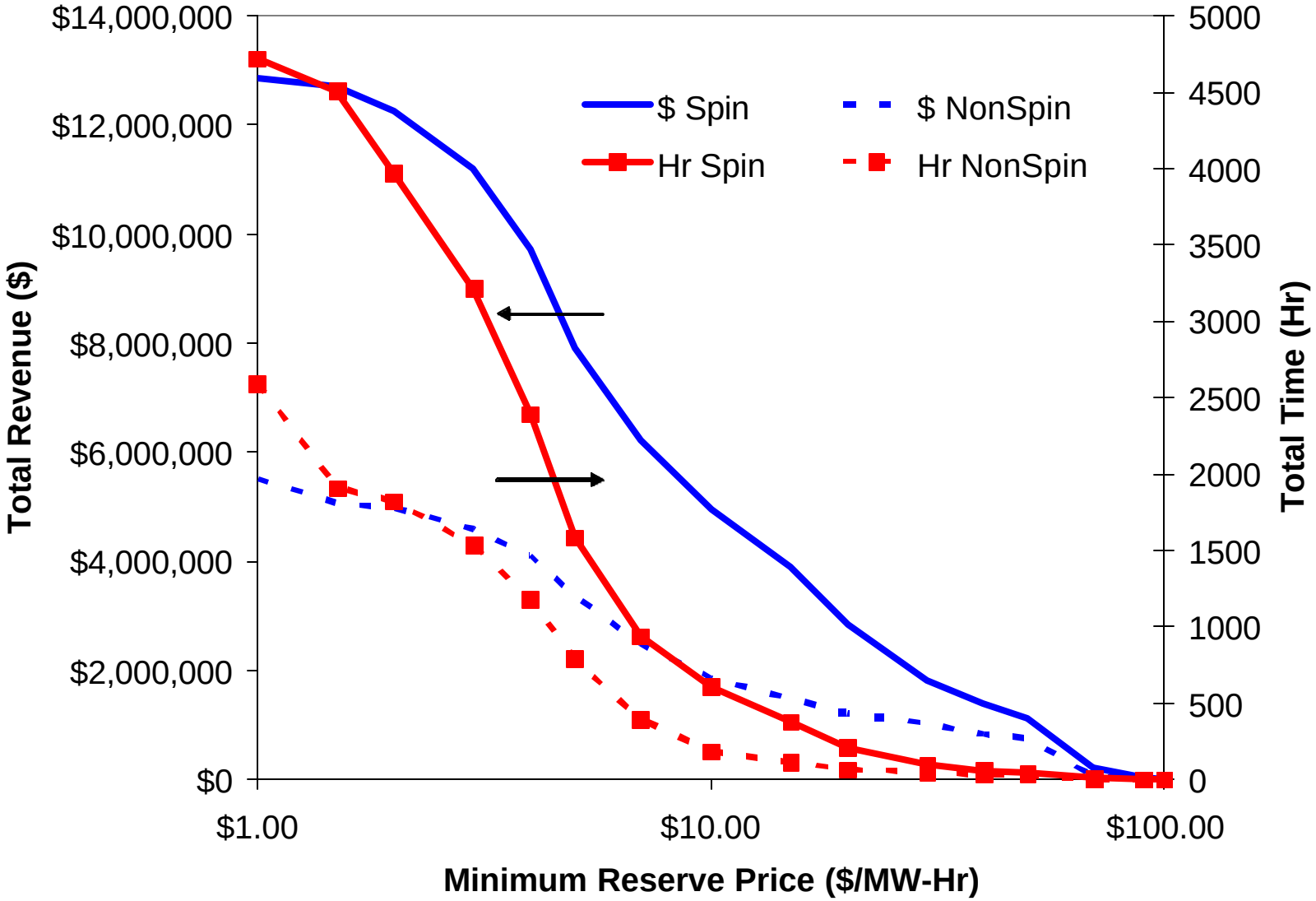
Reactive Power Consumption



Based on a 100-mile 500-kV Line

Reasons for Supplying Spinning Reserve from Load

- **If spin could be supplied from load, more reserves would become available.**
- **More supply: Likely that the price of spinning reserve and energy would be reduced.**
- **The distribution of spinning reserve would be smoother.**
- **Loads would have another dimension of operation, and another source of revenue.**

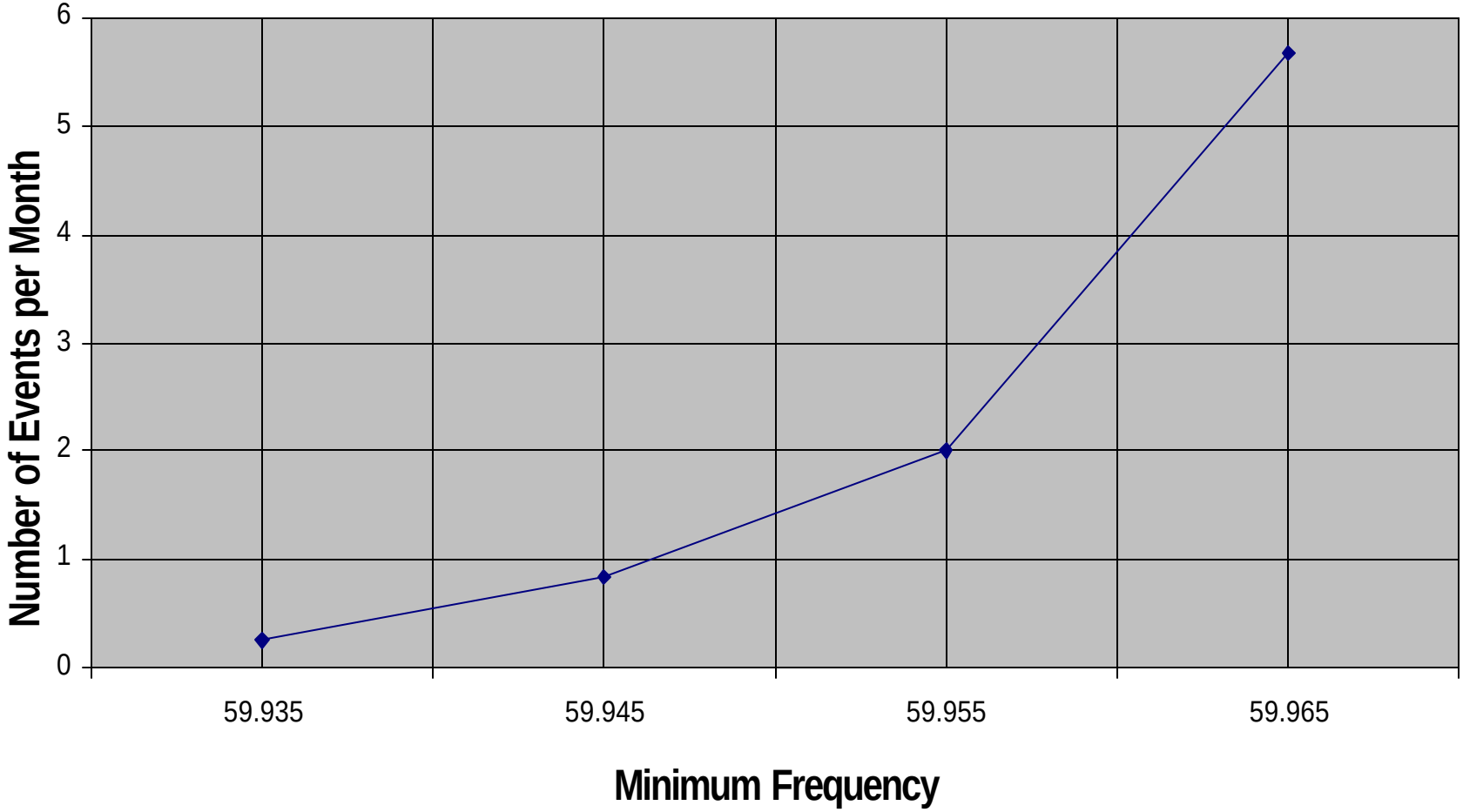


Setting a minimum acceptable price for selling spinning or non-spinning reserve reduces revenue, but it also reduces the exposure to curtailment.

Reasons for Supplying Spinning Reserve from Load

- **Spinning reserve is now supplied from selected generators for economic reasons**
  - **These tend to be grouped in geographic areas.**
  - **This causes the spinning reserve distribution across the control area to be lumpy, not smooth.**
- **When first and second contingencies are modeled, the flow paths from the reserves clustered in groupings must be held open. This can cause transmission congestion.**
- **Congestion can inflate energy market prices.**

WECC Frequency Deviations Due to Loss of Generation for 2002



Spinning Reserve would not be called upon often for frequency deviations.

There Aren't Many Large Frequency Deviations

- **For generation, 6 per month at the threshold of 59.965 Hz**
- **At 59.935 Hz, there was an average of 0.25 per month for 2002.**
- **Load could bid to supply spinning reserve at various frequency levels and create a droop characteristic.**
- **Loads that did not wish to be interrupted often could bid for the lower frequencies.**

Specific Rule Change Request

- **Simply change the definition of spinning reserve to state that it can be supplied from either generation or load.**
- **Individual control areas would still have the authority for implementing the rule, and determining the specific requirements.**

Next Steps

- **We are working with WECC MORC to develop rule change.**
- **Possible testing may be required to evaluate response time of large numbers of small loads.**
- **SCE has indicated that they will be interested in such testing.**
- **Other large loads, (electric and gas utility loads) are interested in participating.**
- **The CDWR report will be condensed and published in a national journal.**
- **We will work with utilities to set up demonstrations.**